

Executive Summary

Southeast United States Hurricane Evacuation Traffic Study

In September 1999, the largest peacetime evacuation ever to take place in the United States occurred as the result of Hurricane Floyd. As a result of massive public response, huge out-of-county and out-of-state evacuee movements, and multiple states loading onto a limited road network within a very short timeframe, traffic congestion reached levels never seen by the public. The public's experience during the Floyd evacuation and their resulting outcry to elected officials and emergency management professionals "to fix the evacuation problem" has resulted in many federal, state, and local initiatives to better manage evacuations.

Study Purpose

At the federal level, under the directives of Vice President Gore, FEMA, USDOT, and the U.S. Army Corps of Engineers joined together to address problems that surfaced during the Floyd evacuation. Specifically, Florida, Georgia, South Carolina and North Carolina were promised that an initial effort would be accomplished by February 2000 to find out what the public did in response to Floyd, to develop a web based travel demand forecast system that would anticipate evacuation traffic congestion and cross state travel flows, and to coordinate with state DOTs on one way strategies and ITS technologies. To assist with this effort, PBS&J was hired as a consultant to produce the necessary products and facilitate the important coordination effort associated with the process.

Documentation and Coordination

Documentation for the study effort includes this Executive Summary and three technical memoranda which focus on three major areas:

Technical Memorandum 1 – Behavioral Analysis

Technical Memorandum 2 – Evacuation Travel Demand Forecasting System

Technical Memorandum 3 – Reverse Lane Standards and ITS Strategies

Each state has been an integral part of the development and review of work products. Staff from each state's emergency management office, department of transportation, and highway patrol have been of great assistance. A web site that was developed by the U.S. Army Corps of Engineers kept study participants abreast of study progress throughout the

study. A brief summary of key findings is provided for each of the three major technical components.

Behavioral Analysis

Hazards Management Group of Tallahassee, Florida was hired to document the public's response to Floyd. Sixty-nine hundred phone interviews focusing on a variety of public response characteristics were accomplished with the public. Residents in coastal surge and non-surge areas, as well as residents in non-coastal areas, were contacted. The number of interviews accomplished in each state was as follows:

North Carolina	1200 interviews
South Carolina	1800 interviews
Georgia	1200 interviews
Florida	<u>2700 interviews</u>
	6900 total interviews

Results from the interviews revealed some of the highest participation rates ever experienced in an evacuation. Participation rates from non-surge areas and inland adjacent counties were quite high and noteworthy. Most evacuees said they left due to notices from public officials and what they were hearing on The Weather Channel and local weather stations.

Of equal importance was the finding that a large percentage of evacuees went out-of-county to find acceptable refuge from the storm.

For Northeast Florida, Savannah, Charleston, and Wilmington (who were major contributors to the evacuation), it is interesting to see a percentage breakdown by state destination. Interstate traffic movements affected evacuations in neighboring states.

Although many other behavioral parameters are documented in Technical Memorandum 1, a final behavioral component is presented regarding public shelter use. These numbers are quite low compared to what would be expected:

Web-based Evacuation Travel Demand Forecasting System

A web based evacuation travel demand model was constructed so that major traffic congestion areas and traffic flows could be anticipated and monitored for a Floyd type event. This important tool was developed using Microsoft's Visual Basic and ESRI's Map Objects, Map Objects IMS, and Arcview. Out-of-county evacuation traffic data

calculated in FEMA/Corps hurricane evacuation study products and Regional Planning Council hurricane studies were used as a baseline for the model.

The model is set up so that a state would dial up the model and input the following for each county responding:

- ☐ Category of hurricane
- ☐ Expected participation rate/compliance rate
- ☐ Tourist occupancy
- ☐ Destination percentages (optional/defaults encouraged)

Once these are submitted for each responding county, the model updates a number of system forecasts and graphics, providing key information for a significant hurricane threat. Other data that can be input real time are hour by hour traffic counts at locations where states have the ability to collect and communicate such information. Florida and South Carolina currently have such a capability at many strategic evacuation roadway locations. As traffic counts are input, accumulated traffic can be compared to system forecasts.

Major outputs of the model include:

- ☐ Expected congestion levels by major highway segment
- ☐ Tables of expected vehicles crossing state lines by direction
- ☐ Comparisons of traffic count station data to forecast condition
- ☐ Numbers of vehicles generated by each county traveling to specific inland locations
- ☐ Route information by segment including number of lanes, facility type, service volume, congestion measure

Ideally, the model will be housed at the FEMA Region IV Regional Operations Center and will become the primary tool by which an Evacuation Liaison Team (ELT) collects and disburses traffic and evacuation information to the states. The process requires that the states submit data and participate in the web site during an actual threat. Meetings will be held in the spring of 2000 to work out operational details of the ELT.

Traffic Conditions, Reverse Lane Standards, and ITS Strategies

All available traffic counts collected by the state DOTs during Floyd were graphed and analyzed. The hour-by-hour and daily count totals confirmed and supported the congestion levels reported by the public and highway patrol. The highest per lane volumes seen during the Floyd evacuation on interstate facilities were between 1500 and 1600 vehicles per lane per hour. The diagrams below show typical traffic count summaries developed with the Floyd traffic data. The locations are I-26 westbound out of Charleston and I-10 westbound out of Jacksonville. Valuable evacuation information regarding evacuation flow, duration, and queuing that can be seen using the data:

Extensive coordination with each state's DOT and highway patrol occurred to review existing one way/reverse lane plans for hurricane evacuations. Meetings were held in each state to discuss every aspect of traffic operations for reverse lane strategies used during Floyd on I-16 in Georgia and I-26 in South Carolina (and yet to be implemented on I-40 in North Carolina and the Florida Turnpike in Florida). Best features of each plan were noted and a comprehensive checklist of features that must be addressed for reverse laning in any location were compiled. The following table shows the features that must be addressed for reverse lane operations and a qualitative assessment of the impacts/benefits that might be present for a contra-flow lane, using a shoulder, or reversing all lanes in one direction:

A final area that was addressed with each state's DOT and highway patrol was that of Intelligent Transportation Systems (ITS) technologies that could be used to manage hurricane evacuations. State by state recommendations were developed and focused on elements of the following ITS technologies:

- ☐ Surveillance systems
- ☐ Traffic information dissemination
- ☐ Freeway control
- ☐ Signal control systems
- ☐ Navigation/route guidance systems
- ☐ Communications between field devices and control centers

- ☐ Incident management systems
- ☐ Automated vehicle location systems
- ☐ Computer aided dispatching

A map was provided showing locations where ITS applications are recommended. Tables were developed with rough cost estimates for each treatment.